PATENT ABSTRACTS OF JAPAN

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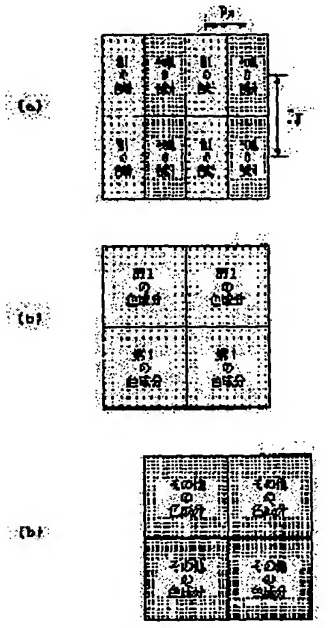
(71)Applicant : NIKON CORP
(72)Inventor : UTAGAWA TAKESHI

(54) IMAGE PICKUP DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide image pickup quality equivalent to a 2-plate type image pickup device by using the image pickup element of a single plate in an image pickup device for picking up optical images.
SOLUTION: This image pickup device is provided with an optical low-pass filter for grading the optical image, a color filter for color-separating the optical image made to pass through the optical low-pass filter through the color array of plural colors and an image pickup means for picking the optical image made to pass through the color filter by plural light receiving pixels arrayed on a light receiving surface. At the time of defining the horizontal pitch of the light receiving pixel as Px and a vertical pitch as Py, the image pickup means is composed by setting the Py to the almost double of the Px. The color filter is composed of the color array where a first color component is arranged in (horizontal every other vertical stripes) or a (check) and the other color components are arranged at remaining positions by matching sections with the array of the light receiving pixels. The optical low-pass filter is a filter for grading the optical image in a horizontal direction for a distance almost equal to the horizontal pitch Px.



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CLAIMS

[Claim(s)]
[Claim 1] The optical low pass filter which obscures the high-frequency component of the spatial frequency of a light figure. The light filter which classifies by color the light figure which passed the aforementioned optical low pass filter through the color array of two or more colors. An image pck-up means to picturize the light figure which passed the aforementioned light filter by two or more light-receiving pixels arranged in the light-receiving side. It is image pck-up equipment equipped with the above. the aforementioned image pck-up means When the level pitch of the aforementioned light-receiving pixel is set to Px and a normal pitch is set to Py, it comes to set Py as the abbreviation double precision of Px. the color array of the aforementioned light filter Or (level perpendicular stripe in every other one) (checker) it arranges. the array of the aforementioned light-receiving pixel -- a partition -- doubling -- the 1st color component -- It comes to arrange other color components in the remaining position, and the aforementioned optical low pass filter is characterized by being the filter with which a light figure is in the aforementioned level pitch Px, abbreviation, etc. by carrying out, and only distance obscures it horizontally.
[Claim 2] The aforementioned image pck-up means is image pck-up equipment with which it consists of two photo detectors to which two-dimensional array of the part for one of the aforementioned light-receiving pixel was carried out in Pitch Px in image pck-up equipment according to claim 1, and is characterized by the bird clapper.
[Claim 3] The color array of the aforementioned light filter is image pck-up equipment which all the kinds of the aforementioned color component are arranged in the same line of the direction short in image pck-up equipment according to claim 1 of the pitch of the aforementioned light-receiving pixel (horizontal direction), and is characterized by the bird clapper.
[Claim 4] When the color component of the above 1st is removed from the aforementioned color array in image pck-up equipment according to claim 3, each of each other color components is image pck-up equipment characterized by making a checkered array.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the image pck-up equipment which picturizes a light figure. It is related with the technology for realizing the image pck-up quality of image about 2 board type image pck-up equipment and equivalent using the image pck-up element of the veneer in more detail.
[0002]
[Description of the Prior Art] Conventionally, the image pck-up equipment of 2 board type is proposed for the purpose of improvement in an image pck-up performance. Drawing 10 is explanatory drawing showing this kind of 2 board type image pck-up equipment. In drawing 10 , a dichroic prism 71 is arranged on the optical axis of photography optical system. This dichroic prism 71 branches an incident light for G component and RB component.
[0003] The image pck-up element 72 only for G is arranged at the branching place of G component. On the other hand, the light filter 74 which consists of a color array of R component and B component is arranged at the branching place of RB component. Just behind this light filter 74, the image pck-up element 73 for RB is arranged. By such composition, highest G component of relative luminous efficiency is picturized with 2 board type image pck-up equipment at high resolution using the image pck-up element 72 of exclusive use.
[0004] Since the light-receiving side whole region of the image pck-up element 72 is moreover covered by the light-receiving pixel of G component, it is hard coming to generate a false color, moire, etc. Moreover, as shown in drawing 10 , it also becomes possible by shifting spatially the pixel position of the image pck-up element 72, and the pixel position of the image pck-up element 73, and arranging them to raise the resolution of an image pck-up picture substantially. With 2 board type image pck-up equipment, human being's visual sense is suited and good image pck-up quality of image with sufficient balance can be obtained from these reasons.
[0005]
[Problem(s) to be Solved by the Invention] By the way, with the image pck-up equipment of 2 board type mentioned above, in order to branch an incident light, large-sized optical elements, such as a dichroic prism 71, are arranged. Therefore, there were optical system's being complicated and a trouble of enlarging. Moreover, the pixel position of two image pck-up elements 72 and 73 had to be adjusted with high precision, and there was a trouble of taking time and effort like an assembler.
[0006] Then, in invention according to claim 1 to 4, in order to solve the trouble mentioned above, it aims at realizing the image pck-up quality of image about 2 board type image pck-up equipment and equivalent with the image pck-up equipment of the veneer. Especially, it aims at offering usable image pck-up equipment for the image pck-up element of a square pixel in invention according to claim 2. Moreover, by invention of a publication, it aims at offering the image pck-up equipment suitable for interpolation processing of a color component to claims 3 and 4.
[0007]
[Means for Solving the Problem] The optical low pass filter to which invention according to claim 1 obscures the high-frequency component of the spatial frequency of a light figure, (Claim 1) In image pck-up equipment equipped with the light filter which classifies by color the light figure which passed the optical low pass filter through the color array of two or more colors, and an image pck-up means to picturize the light figure which passed the light filter by two or more light-receiving pixels arranged in the light-receiving side When an image pck-up means sets the level pitch of a light-receiving pixel to Px and a normal pitch is set to Py, it comes to set Py as the abbreviation double precision of Px. a light filter Or (level perpendicular stripe in every other one) (checker) it arranges. the array of a light-receiving pixel - a partition -- doubling -- the 1st color component -- It consists of a color array which has arranged other color components in the remaining position, and an optical low pass filter is characterized by being the filter with which a light figure is in the level pitch Px, abbreviation, etc. by carrying out, and only distance obscures it horizontally.

[0008] With such composition, the light-receiving pixel of an image pck-up means is set as aspect ratio Px:Py (**1:2). Before this image pck-up means, the light filter which consists of a color array as shown in drawing 1 (a) or drawing 2 (a) is arranged. Here, drawing 1 (a) is a color array in the case of having arranged the 1st color component in the shape of a perpendicular stripe. Moreover, drawing 2 (a) is a color array in the case of having arranged the 1st color component in the shape of a checker. The light-receiving pixel of an image pck-up means is assigned to the object for the 1st color components, and other color components 1 pixel of every horizontals by such color array.

[0009] Furthermore, the optical low pass filter to which the level pitch Px, abbreviation, etc. are by carrying out before a light filter, and only distance obscures a light figure horizontally is arranged. By shading-off operation of this optical low pass filter, the light of the 2nd division fraction mixes and carries out incidence to the 1st division fraction of a color array. Therefore, the range (henceforth a "light-receiving aperture") which the amount of one light-receiving pixel receives is extended by about twice horizontally (namely, the direction of a shorter side), and turns into a square-like range mostly.

[0010] Consequently, the light-receiving aperture for the 1st color components spreads to a contiguity partition, as shown in drawing 1 (b) or drawing 2 (b), and it fills the whole simultaneously of a light-receiving side. Moreover, the light-receiving aperture for other color components also spreads to a contiguity partition, as shown in drawing 1 (c) or drawing 2 (c), and it fills the whole simultaneously of a light-receiving side. Since the array pattern of the light-receiving aperture shown in such drawing 1 becomes being the same as that of the pixel pattern of the conventional example (drawing 10), it becomes possible [realizing simply the image pck-up quality of image about 2 board type image pck-up equipment and equivalent using the image pck-up element of the veneer].

[0011] Also in the array pattern of the light-receiving aperture shown in drawing 2 , since it becomes an array just like the pixel pattern of the conventional example (drawing 10), it becomes possible to realize simply the image pck-up quality of image about 2 board type image pck-up equipment and equivalent also in this case using the image pck-up element of the veneer. Moreover, as it is indicated in drawing 1 or drawing 2 as "the light-receiving aperture for the 1st color components", and "the other light-receiving apertures for color components", only a pitch Px shifts horizontally. Therefore, it also becomes possible to acquire the almost same effect as the case where space pixel staggering is performed in 2 board type image pck-up equipment.

[0012] Incidentally, in order to make completely equivalent image pck-up quality of image, it is necessary to increase the horizontal resolution of an image pck-up means to about [of the conventional example] twice. However, since the resolution of an image pck-up means is improving every year, it is very easy to realize image pck-up quality of image completely equivalent to 2 board type image pck-up equipment of the old mold with the veneer composition of this invention.

Furthermore, 2-dimensional sampling is performed by the light-receiving aperture by which the 1st color component in a light figure has been mostly arranged in the same pitch at the level perpendicular direction. Therefore, about the 1st color component of a picture signal, it becomes possible to acquire the signal of a square pixel easily, without passing through processing of complicated aspect conversion etc. Therefore, in a computer related field with treating [much] the signal of a square pixel, suitable image pck-up equipment is especially realizable.

[0013] In addition, the word "perpendicular" is used ["level" and] in this application. However, these are the language meaning the mutual relative sense, are matched in the absolute directions of a light figure or equipment (scanning direction of an image pck-up element etc.), and do not limit a meaning. Moreover, in this application, a plain expression of "Px, abbreviation, etc. being by carrying out and obscuring only distance" is used. If this is said in detail, it will be the meaning of having the spatial frequency characteristics of a grade which pile up the shifted light figure, Px mostly to the original light figure.

[0014] What is necessary is just to apply to the above-mentioned meaning as it is, since a light figure is generally shifted and piled up simply in the case of the optical low pass filter which used the birefringence. On the other hand, since a high order component, bleeding (the so-called halo) of light, etc. arise in the case of the optical low pass filter which used the phase grating etc., it cannot be said that two light figures are piled up simply. However, "the spatial frequency characteristics of a grade which piles up the light figure mostly shifted Px to the original light figure" is realizable by allotting the zero point of spatial frequency characteristics near [the 1/(2Px)], or performing a filter design, such as making the same a part for the shoulder of a low-pass property also in such a case.

[0015] (Claim 2) In image pck-up equipment according to claim 1, an image pck-up means consists of two photo detectors to which two-dimensional array of the part for one of a light-receiving pixel was carried out in Pitch Px, and invention according to claim 2 is characterized by the bird clapper. It becomes possible to use the general image pck-up element which consisted of square pixels for this invention by such composition.

[0016] (Claim 3) It sets to image pck-up equipment according to claim 1, and invention according to claim 3 is the color array of the aforementioned light filter. All the kinds of the aforementioned color component are arranged in the

same line of the short direction of the pitch of the aforementioned light-receiving pixel (horizontal direction), and it is characterized by the bird clapper. As shown in drawing 1 or drawing 2 , the phase of a level line can be made in agreement by the light-receiving aperture of the 1st color component, and the light-receiving aperture of other color components. Therefore, it becomes possible by arranging all the kinds of color component beforehand in level 1 line to acquire the information on the color component of all kinds for every level line. Consequently, the things (for example, interpolation etc.) for which the color component of all kinds is presumed by the simple horizontal image processing become possible.

[0017] (Claim 4) Invention according to claim 4 In image pck-up equipment according to claim 3, if the color component of the above 1st is removed from the aforementioned color array, each of each other color components will be characterized by making a checkered array. By adopting such a color array, each light-receiving aperture of each other color components is arranged in checkers. Therefore, about each other color components, a part for the adjoining horizontal of two lines is used, and it becomes possible to restore nearly completely the sexual desire news for the horizontal of one line. Consequently, it becomes possible to presume each other color components to accuracy further using a simple 2-dimensional image processing (for example, interpolation).

[0018]

[Embodiments of the Invention] Hereafter, the form of the operation in this invention is explained based on a drawing.

[0019] (1st operation form) The 1st operation form is an operation form corresponding to claims 1-4. Moreover, the 1st operation form is an operation form applicable to the color array shown in drawing 1 . Drawing 3 is explanatory drawing showing the equipment configuration of the 1st operation form. In drawing 3 , the optical low pass filter 12, a light filter 13, and the image pck-up element 14 are arranged in order along with the optical axis of the photography optical system 11.

[0020] This image pck-up element 14 is an image pck-up element of a square pixel, and two-dimensional array of the photo detector 16 is carried out in Pitch Px on a light-receiving side. Between the vertical files of this photo detector 16, the perpendicular transfer line 17 which consists of a CCD line, an MOS switch group, etc. is arranged. Moreover, the level transfer line 18 is arranged along with the outgoing end of these perpendicular transfers line 17. The output amplifier 19 is connected to the outgoing end of this level transfer line 18.

[0021] Moreover, on the other hand, the light-receiving pixel 15 which is the pixel unit of an image pck-up picture consists of two perpendiculars of a photo detector 16. Consequently, a part for one of the light-receiving pixel 15 is set as aspect ratio Px:Py=1:2. A position is doubled, it is subdivided by each light-receiving pixel 15, and a light filter 13 is classified by RGB3 color by color, respectively. Here, odd lines of the light-receiving pixel 15 are classified by "GRGB .." by color, and even lines is classified by "GBGR .." by color (this color array is called "deformation A of a stripe array").

[0022] The optical low pass filter 12 is the optical element which cut down crystal etc. in accordance with the predetermined shaft, and is a filter with which only distance delta x obscures a light figure horizontally using a birefringence operation of a normal beam of light and an extraordinary ray (it shifts). This distance delta x is set up equally to the level pitch Px of the light-receiving pixel 15 by adjusting the thickness of the optical low pass filter 12.

[0023] (Correspondence relation between this invention and the 1st operation form) Here, about the correspondence relation between invention according to claim 1 to 4 and the 1st operation form, an optical low pass filter corresponds to the optical low pass filter 12, a light filter corresponds to a light filter 13, and an image pck-up means corresponds to the image pck-up element 14.

[0024] (Operation of the 1st operation form) Operation of the 1st operation form is explained hereafter. Drawing 4 is drawing explaining operation of the 1st operation form. A light figure is formed in an image space side of an image formation operation of the photography optical system 11. The birefringence of this light figure is carried out, and, as for the optical low pass filter 12, only Px obscures it horizontally. Thus, after the obscured light figure is classified by the three primary colors by color through a light filter 13, it is projected on the light-receiving side of the image pck-up element 14. At this time, the pixel outputs (specifically a signal charge, optical voltage, a photocurrent, etc.) according to the luminosity occur in each of a photo detector 16 on a light-receiving side. Here, the pixel output for two perpendiculars is added by passing through one process for example, of (1) - (4).

[0025] (1) In case a pixel output is transmitted to the perpendicular transfer line 17 from a photo detector 16, add the pixel output for two perpendiculars.

[0026] (2) Add the pixel output for two perpendiculars on a transfer line after the transfer start of the perpendicular transfer line 17.

[0027] (3) From the perpendicular transfer line 17, in case a pixel output is transmitted to the level transfer line 18, add the pixel output for two perpendiculars.

[0028] (4) Add the pixel output for two perpendiculars by signal processing after the output of the output amplifier 19

in the outgoing end of the level transfer line 18. The pixel output which made the light-receiving pixel 15 of the shape of a rectangle as shown in drawing 3 one unit of a pixel by one of such addition processings is generated. By the way, the optical low pass filter 12 is arranged before a light-receiving side, and as shown in drawing 4 (b), only Px obscures a light figure horizontally. Therefore, the light equivalent to the level 2nd division fraction mixes and carries out incidence to one partition of a color array. Therefore, the light-receiving aperture of the light-receiving pixel 15 is horizontally extended the degree of double degree, as shown in drawing 4 (c).

[0029] Consequently, the light-receiving aperture for G components covers the whole simultaneously of a light-receiving side independently. Moreover, the light-receiving aperture of RB component also covers the whole simultaneously of a light-receiving side. Moreover, as for "the light-receiving aperture for G components", and "the light-receiving aperture for RB components", only a half-phase shifts horizontally at this time. The array of such a light-receiving aperture turns into an array just like the conventional example (drawing 10) of 2 board type image pck-up equipment.

[0030] (spatial frequency characteristics in the 1st operation form) Next, the reduction effect of a false color or moire in G component is explained from a viewpoint of spatial frequency. Drawing 5 (a) is drawing showing the spatial frequency characteristics of the optical low pass filter 12. As shown in this view, the trap property centering on a horizontal frequency [1/(2Px)] is shown.

[0031] Moreover, a light figure is equalized by every [of the light-receiving pixel 15] light-receiving field (Width Px, length Py) on a light-receiving side. Drawing 5 (b) is drawing showing the spatial frequency characteristics in this equalization processing. As shown in this view, the trap property consisting mainly of a horizontal frequency [1/Px] and perpendicular frequency [1/Py] is shown. Drawing 5 (c) is the spatial frequency characteristics which compounded and searched for two properties mentioned above. As shown in this view, the spatial-frequency component near a horizontal frequency [1/(2Px)] and the perpendicular frequency [1/Py] is suppressed strongly.

[0032] At this time, since two-dimensional sampling is carried out with a level pitch [2Px] and a normal pitch [Py], clinch noise (dotted-line portion in drawing 6) as shown in drawing 6 (a) generates the picture signal of G component. However, the high-frequency component of the HARASHIN number (slash portion in drawing 6) is beforehand suppressed in the property of drawing 5 (c) mentioned above. Therefore, it becomes it is few and possible [suppressing the false color and moire of G component exactly] for noise to occur by return into the low-pass portion of the HARASHIN number.

[0033] (Effect of the 1st operation form etc.) As explained above, the color array of a light-receiving aperture turns into a color array of the light-receiving pixel in the conventional example (drawing 10), and a well alike array. Therefore, it becomes possible to realize simply the image pck-up quality of image about 2 board type image pck-up equipment and equivalent using the image pck-up equipment of the veneer. Moreover, the 1st operation form constitutes a part for one from two perpendiculars of the square light-receiving pixel 16 of the rectangular light-receiving pixel 15. Therefore, it becomes possible to divert the image pck-up element 14 of a general square pixel, without using the special image pck-up element which consists of a long direction pixel.

[0034] Moreover [especially], with the 1st operation form, only Px has obscured the light figure exactly horizontally. Therefore, neither a crevice nor a lap arises at all in the array of a light-receiving aperture. Therefore, the resolution of an image pck-up picture also becomes possible [raising to the maximum], raising the numerical aperture of a light-receiving aperture to the maximum. Furthermore, with the 1st operation form, the sexual desire news of all RGB can be obtained from the light-receiving aperture for level 1 line. Therefore, using a simple horizontal image processing, it cannot leak and G component and RB component in phase can be presumed (in addition, the example of processing is explained in full detail in the 6th operation form).

[0035] Moreover, with the 1st operation form, "the light-receiving aperture of R component" and "the light-receiving aperture of B component" are formed in the shape of a checker, respectively. Therefore, it also becomes possible from the sexual desire news for the adjoining horizontal of two lines to restore nearly completely R component and B component for the horizontal of one line (in addition, the example of processing is explained in full detail in the 6th operation form). Next, another operation form is explained.

[0036] (2nd operation form) The 2nd operation form is an operation form corresponding to invention according to claim 1 to 3. Moreover, the 2nd operation form is an operation form applicable to the color array shown in drawing 1 . Drawing 7 (a) is explanatory drawing of the 2nd operation form. The 2nd operation form is an operation form at the time of making the color array of a light filter into the perpendicular stripe which consists of "GRGBGRGB ..."

[0037] Also in such a color array, when only Px obscures a light figure horizontally, the thing of a light-receiving side for which the whole is covered mostly becomes possible by the light-receiving aperture for G components. Moreover, the thing of a light-receiving side for which the whole is mostly covered in the shape of a vertical stripe becomes possible also about the light-receiving aperture for RB components. Thus, the array composition of a light-receiving

aperture turns into array composition in the conventional example (drawing 10), and well alike composition. Therefore, it becomes possible to realize simply using the image pck-up equipment of the veneer which shows the image pck-up quality of image about 2 board type image pck-up equipment and equivalent to the 3rd operation form. Furthermore, with the 2nd operation form, the sexual desire news of all RGB can be obtained from the light-receiving aperture for level 1 line. Therefore, it becomes possible not to leak and to presume G component and RB component in phase using a simple horizontal image processing.

[0038] (3rd operation form) The 3rd operation form is an operation form corresponding to invention given in claims 1 and 2. Moreover, the 3rd operation form is an operation form applicable to the color array shown in drawing 1 . Drawing 7 (b) is explanatory drawing of the 3rd operation form. The 3rd operation form is an operation form at the time of setting the color array of a light filter to "GRGR .." about odd lines, and setting it to "GBGB .." about even lines (this color array is called "deformation B of a stripe array").

[0039] Also in such a color array, when only Px obscures a light figure horizontally, the thing of a light-receiving side for which the whole is covered mostly becomes possible by the light-receiving aperture for G components. Moreover, the thing of a light-receiving side for which the whole is covered mostly becomes possible also about the light-receiving aperture for RB components. Thus, the array composition of a light-receiving aperture becomes completely the same as that of the array composition in the conventional example (drawing 10). Therefore, it becomes possible to realize simply using the image pck-up equipment of the veneer which shows the image pck-up quality of image about 2 board type image pck-up equipment and equivalent to the 3rd operation form.

[0040] (4th operation form) The 4th operation form is an operation form corresponding to invention given in claims 1 and 2. Moreover, the 4th operation form is an operation form applicable to the color array shown in drawing 2 . Drawing 7 (c) is explanatory drawing of the 4th operation form. The 4th operation form is an operation form at the time of making the color array of a light filter into a Bayer array.

[0041] Also in such a color array, when only Px obscures a light figure horizontally, the light-receiving aperture for G components is arranged in a slanting grid, and the thing of a light-receiving side for which the whole is covered mostly becomes possible. Moreover, the thing of a light-receiving side for which the whole is covered mostly becomes possible also about the light-receiving aperture for RB components.

[0042] Thus, the array composition of a light-receiving aperture turns into array composition in the conventional example (drawing 10), and well alike composition. Therefore, it becomes possible to realize simply using the image pck-up equipment of the veneer which shows the image pck-up quality of image about 2 board type image pck-up equipment and equivalent to the 4th operation gestalt. furthermore, as an effect peculiar to the 4th operation gestalt, it is the point which can constitute the light-receiving aperture for G components in a slanting grid Thus, by constituting the light-receiving aperture for G components in a slanting grid, it becomes possible to raise the resolution of G component substantially.

[0043] (5th operation form) The 5th operation form is an operation form corresponding to invention according to claim 1 to 3. Moreover, the 5th operation form is an operation form applicable to the color array shown in drawing 2 . Drawing 7 (d) is explanatory drawing of the 5th operation form. The 5th operation form is an operation form at the time of setting the color array of a light filter to "GRGB .." about odd lines, and setting it to "RGBG .." about even lines.

[0044] Also in such a color array, when only Px obscures a light figure horizontally, the light-receiving aperture for G components is arranged in a slanting grid, and the thing of a light-receiving side for which the whole is covered mostly becomes possible. Moreover, the thing of a light-receiving side for which the whole is covered mostly becomes possible also about the light-receiving aperture for RB components.

[0045] Thus, the array composition of a light-receiving aperture turns into array composition in the conventional example (drawing 10), and well alike composition. Therefore, it becomes possible to realize simply using the image pck-up equipment of the veneer which shows the image pck-up quality of image about 2 board type image pck-up equipment and equivalent to the 5th operation form. Moreover, with the 5th operation form, the sexual desire news of all RGB can be obtained from the light-receiving aperture for level 1 line. therefore, as an effect still more peculiar to the 5th operation form that it cannot leak and G component and RB component in phase can be presumed using a simple horizontal image processing, it is the point which can constitute the light-receiving aperture for G components in a slanting grid Thus, by constituting the light-receiving aperture for G components in a slanting grid, it becomes possible to raise the resolution of G component substantially. Next, another operation form is explained.

[0046] (6th operation form) The 6th operation form is an operation form which shows concretely an example of interpolation processing of RB component suitable for the 1-3rd operation forms mentioned above. Here, the case where the picture output to which all RGB values were equal in the position of each square pixel is generated supposing the output of a digital still camera etc. is explained.

[0047] First, in the operation form of these 1-3rds, as shown in drawing 8 (a), the light-receiving aperture of G component is formed in an every direction same pitch. Therefore, the signal of G component which consists of a square pixel and high resolution is generable soon by taking out the pixel output of G component as it is. On the other hand, about RB component, since the signal of G component and a signal in phase are ungenerable soon, interpolation processing is needed. At this time, the point that it should mind is a point that half-phase shift ****** is not horizontally shifted perpendicularly by the light-receiving aperture of G component, and the light-receiving aperture of RB component, with the 1-3rd operation forms.

[0048] First, the suitable interpolation processing for the color array of the 1st operation form is shown. Here, in order to obtain a better interpolation result, as follows, interpolation processing with a horizontal direction and a perpendicular direction is distinguished, and is performed. It judges [horizontal or] first whether the degree of similar is high to vertical any as the 1st phase about the G component G (i, j) in the position (i, j) shown in drawing 8 (a). There is a method of asking for the vertical curvature Pt shown in a lower formula and the horizontal curvature Py as the 1st method of asking for the degree of similar of G component.

[0049] Pt(i, j) =|2 and G(i, j)-G(i, j-1)-G(i, j+1) |Py(i, j) =|2 and G(i, j)-G(i-1, j)-G(i+1, j) | -- it is thought in this case in the direction where curvature is small that the degree of similar is high Therefore, if it becomes Pt(i, j) >=Py (i, j), it will judge with similarity being high horizontally, and if it becomes other than this, it will judge with similarity being high perpendicularly. Moreover, there is a method of calculating the amount Ct about the vertical degree of correlation shown in a lower formula and the amount Cy about the horizontal degree of correlation as the 2nd method of asking for the degree of similar of G component.

[0050] Ct(i, j) =|G(i, j)-G(i, j-1) |+|G(i, j)-G(i, j+1) |Cy(i, j) =|G(i, j)-G(i-1, j) |+|G(i+1, j)-G(i, j) | -- in this case It is thought in the direction where the amount about the degree of correlation is small that the degree of similar is high. Therefore, if it becomes Ct(i, j) >=Cy (i, j), it will judge with similarity being high horizontally, and if it becomes other than this, it will judge with similarity being high perpendicularly. In addition, about the amounts Ct and Cy about the degree of correlation, it is possible not only an upper formula but to ask for example, from the following formula.

[0051] Ct =|G (i, j) (i, j)-G(i, j-1) |+|G(i-1, j)-G(i-1, j-1) |Cy(i, j) =|G(i, j)-G(i-1, j) |+|G(i, j-1)-G(i-1, j-1) | -- as the 2nd phase next According to the judgment of the above degrees of similar, one of the interpolation processings of following (1) and (2) is performed alternatively.

[0052] (1) When judged with the horizontal degree of similar being high, as shown in drawing 8 (b), the perpendicular phase of RB line [G lines and] corresponds from the first. Therefore, when the horizontal degree of similar is high It becomes possible to ask for interpolation signal R' (i, j) of a position (i, j), and B' (i, j) with high precision by choosing the RB components R0 and B0 which approach G (i, j) most in a level list, and being referred to as R'(i, j) =R0B'(i, j) =B0.

[0053] (2) Since the level phase of G lines and RB line has shifted in this case when judged with the vertical degree of similar being high, it cannot ask for interpolation signal R' of a position (i, j), and B' in simple perpendicular interpolation of R or B. However, in the color array of the 1st operation form, since the light-receiving aperture of RB component is formed in checkers, respectively, when the vertical degree of similar is high, it becomes possible to substitute the same color component of the level line of one of the upper and lower sides for the empty position of RB component in a level line.

[0054] Then, G (i, j) shown in drawing 8 (c) is substituted for B component of R0 position which carries out left contiguity from the height of the degree of perpendicular similar B1. Moreover, G (i, j) is substituted for R component of B0 position which carries out right contiguity from the height of the degree of perpendicular similar R1. It becomes possible after such substitution to ask for interpolation signal R' (i, j) of R'(i, j) = (R0+R1) / 2B'(i, j) = (B0+B1) / 2 position (i, j), and B' (i, j) by performing the following level interpolation.

[0055] By performing the above interpolation processings, it becomes possible about the color array of the 1st operation form to perform highly precise interpolation processing especially. On the other hand, in the color array of the 2nd operation form, the light-receiving aperture of RB component is formed in the shape of a perpendicular stripe. Therefore, interpolation processing when the above-mentioned vertical degree of similar is high cannot be performed.

[0056] Then, especially in the color array of the 2nd operation form, the RB components R0 and B0 which approach G (i, j) most in a level list are chosen, without judging the degree of similar. It is referred to as R'(i, j) =R0B'(i, j) =B0, and asks for interpolation signal R' (i, j) of a position (i, j), and B' (i, j).

[0057] In this case, highly precise interpolation processing is attained about the photographic subject of level stripes or a level edge. However, about the photographic subject of perpendicular stripes or a perpendicular edge, it becomes the interpolation processing in which quality was inferior a little. Moreover, on the other hand in the color array of the 3rd operation form, the light-receiving aperture of RB component is formed in the shape of a level stripe. In this case, within 1 level line, all RGB colors do not gather but either of the RB components is surely missing.

[0058] Therefore, when the degree of similar is horizontally high, about the color component which touches the right-and-left both sides of G (i, j) recently, highly precise interpolation is attained with simple level interpolation etc. However, about the color component which does not exist in a level line, since simple level interpolation cannot be performed, the interpolation value of a contiguity line with the comparatively low degree of similar will be substituted unavoidably. Therefore, about high RB component of spatial frequency, it becomes difficult to obtain sufficient interpolation result.

[0059] Moreover, perpendicularly, when the degree of similar is high, about the color component which touches the right-and-left both sides of G (i, j) recently, a certain amount of interpolation is attained with simple level interpolation etc. Furthermore, about the color component which does not exist in a level line, the interpolation value of a contiguity line with the comparatively high degree of similar will be substituted. Therefore, so highly precise a interpolation result is not obtained about high RB component of spatial frequency. Explanation of the above interpolation processings shows that it is desirable to arrange the color component of all kinds (composition of a claim 3) in a level line as a color array of a light filter. Furthermore, as a color array of a light filter, it turns out that it is much more desirable to arrange RB each component in the shape of a checker (composition of a claim 4).

[0060] (variation of an operation gestalt) In addition, with each operation gestalt mentioned above, in order to make resolution and the numerical aperture of a light-receiving aperture into the maximum, the case where only Px obscured a light figure exactly horizontally was explained. However, this invention is not limited to this. The effect of this invention can be somewhat acquired by [by which abbreviation etc. generally spreads the distance delta x which obscures a light figure on the level pitch Px] carrying out. For example, it is the distance delta x which obscures a light figure as the spatial frequency characteristics of an optical low pass filter are shown in drawing 9 (a) - (c) <=(0.6Px) deltax<= (1.5Px)

Even if it sets up by ********, it becomes possible to suppress the clinch noise of G component.

[0061] In addition, although the operation gestalt mentioned above explained the case where anisotropy crystals, such as crystal, were used, as an optical low pass filter, this invention is not limited to this. Generally, if it is the optical element to which only predetermined distance obscures a light figure, it can be used as an optical low pass filter. For example, you may use the optical low pass filter which used the phase grating.

[0062] Moreover, although the operation gestalt mentioned above explained the case where assigned G component as the 1st color component, and RB component was assigned to other color components, this invention is not limited to this. For example, the color of a complementary color system can be suitably assigned to these color components, or various modes, such as assigning Y component, can be considered. Furthermore, although several examples were given and the color array of a light filter was concretely explained with the operation gestalt mentioned above, this invention of it not being what is limited only to several of these examples is natural.

[0063] Moreover, with the operation gestalt mentioned above, although a part for one of the light-receiving pixel 15 is constituted from a part for two of a photo detector 16, this invention is not limited to this. For example, as shown in drawing 3 , a part for one of the light-receiving pixel 25 may consist of parts for one of a photo detector 26. Moreover, it is good also considering three or more blocks of a photo detector as a part for one of a light-receiving pixel. Furthermore, although the operation gestalt mentioned above explained the case where arranged a phase and the light-receiving pixel 15 was arranged to a level perpendicular, this invention is not limited to this. Generally, the normal pitch Py of a light-receiving pixel should just be set as the abbreviation double precision of the level pitch Px. For example, even if it arranges a light-receiving pixel in a slanting grid, it is easy to be natural by shifting the phase of an array, without changing a pitch.

[0064]

[Effect of the Invention] (Claim 1) by invention according to claim 1, the light-receiving aperture for the 1st color components shows drawing 1 (b) or drawing 2 (b) -- as -- a light-receiving side -- the whole is covered mostly Moreover, the light-receiving aperture for other color components also covers the whole simultaneously of a light-receiving side, as shown in drawing 1 (c) or drawing 2 (c).

[0065] Therefore, in this invention, it becomes possible to picturize the pixel pattern just like the conventional example (drawing 10) of 2 board type image pck-up equipment. Consequently, it becomes possible to realize simply the image pck-up quality of image about 2 board type image pck-up equipment and equivalent using the image pck-up element of the veneer. Consequently, in order to branch an incident light, it is not necessary to prepare a dichroic prism, and it becomes simply possible about optical system to miniaturize.

[0066] Moreover, especially the need of establishing two or more image pck-up meanses is lost, positioning between image pck-up meanses etc. can be excluded, and it becomes possible to simplify like the assembler of image pck-up equipment sharply. Moreover, in this invention, the aspect ratio of a light-receiving pixel is set as "Px:Py**1:2." Therefore, the configuration of each light-receiving aperture becomes square-like mostly. Therefore, the picture signal

of the pixel aspect ratio 1:1 can be generated quickly and simple, without passing through complicated computations, such as aspect conversion. Therefore, the optimal image pck-up equipment for a computer related field with treating [much] the picture of a square pixel is realizable.

[0067] (Claim 2) Invention according to claim 2 constitutes a part for one of a light-receiving pixel from two photo detectors by which two-dimensional array was carried out in Pitch Px. Therefore, it becomes possible to use the general image pck-up element which consisted of square pixels for this invention.

[0068] (Claim 3) level in invention according to claim 3 -- level, since all the kinds of color component are beforehand arranged in one line -- it becomes possible to acquire the information on the color component of all kinds for every line Consequently, it becomes possible not to leak and to presume the color component of all kinds only by level processing.

[0069] (Claim 4) By invention according to claim 4 Each light-receiving aperture of each other color components is arranged in checkers. Therefore, it becomes possible from a part for the adjoining horizontal of two lines to presume the information on each other color components to accuracy further.

[Translation done.]

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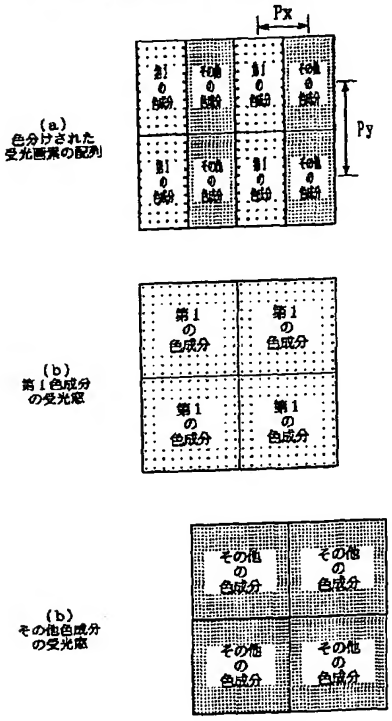
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

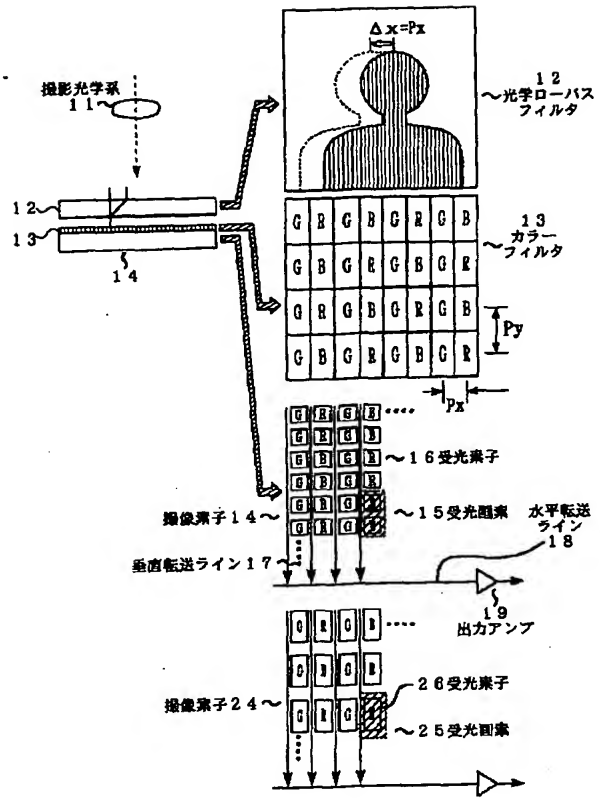
DRAWINGS

[Drawing 1]

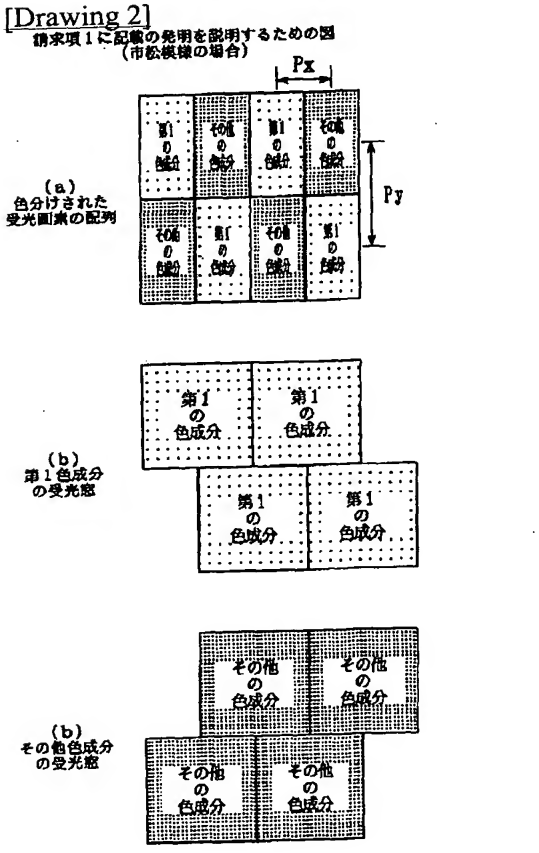
請求項1に記載の発明を説明するための図
(垂直ストライプの場合)



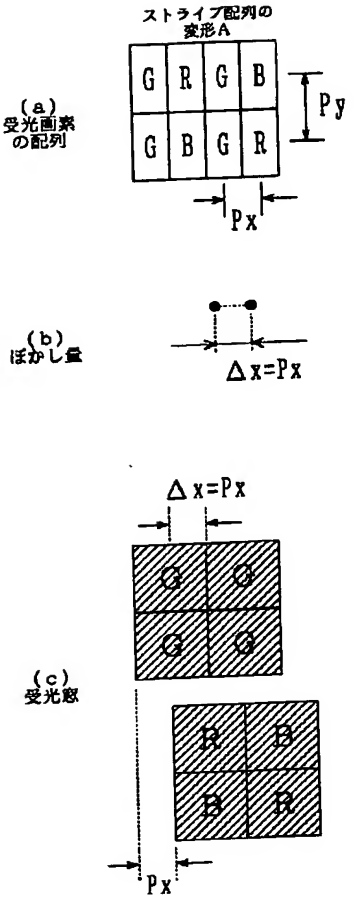
[Drawing 3]



[Drawing 2]

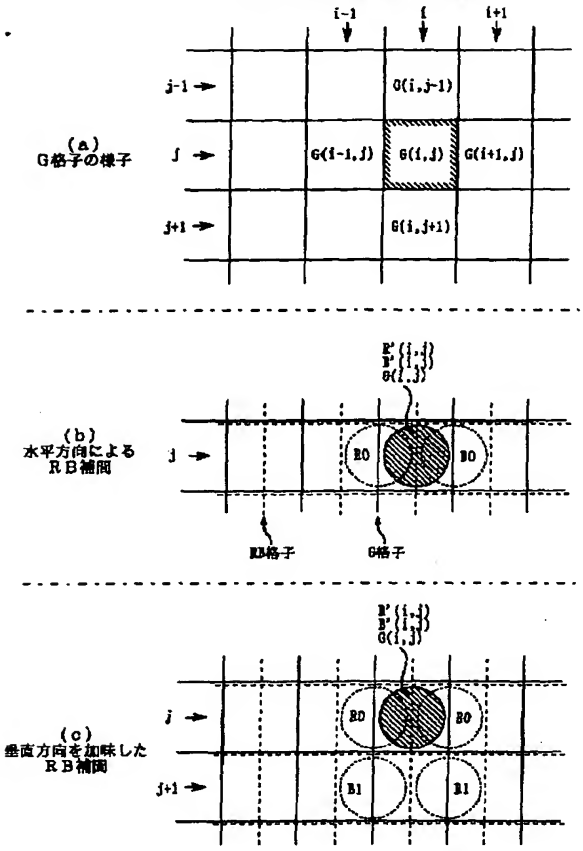


[Drawing 4]


ストライプ配列の
変形A
(a)
受光画素
の配列
G R G B
G B G R
Py
Px
(b)
ぼかし量
Δx=Px
Δx=Px
(c)
受光窓
G G
G G
R B
B R
Px

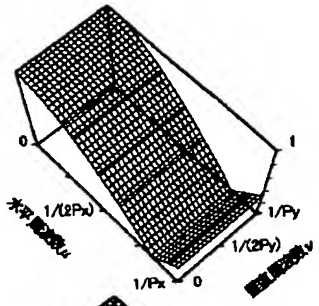
[Drawing 5]

第６の実施形態を説明する図

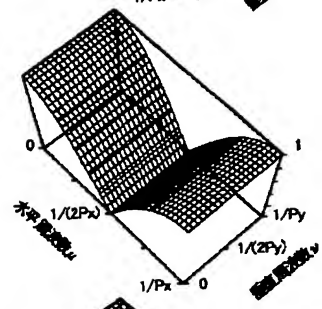


[Drawing 9]

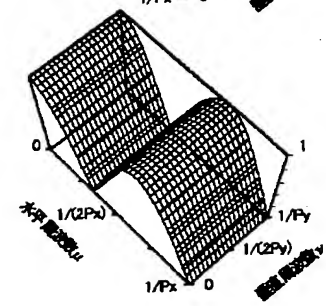
(a)
Δx=0.6Px
の場合



(b)
Δx=Px
の場合



(c)
Δx=1.5Px
の場合



[Translation done.]